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TRW

# Distributed Computing Design System(DCDS) Final Report

CDRL A005
30 September 1993

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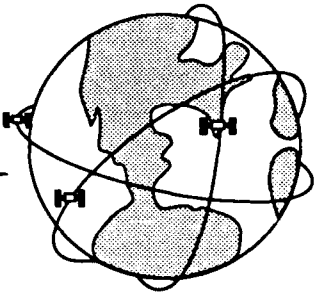

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Under Contract
DASG60-90-C-0092

Prepared For:

The U.S. Army Space &Strategic Defense Command
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G002.VOB.93-3268
30 September 1993

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Attention: CSSD-SA-SS
CSSD-IM-PA
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Subject: Contract No. DASG60-90-C-0092
CDRL Sequence Number A005
Distributed Computing Design System (DCDS)
Final Report

In accordance with the requirements of the subject CDRL, six copies of the report are hereby submitted. Two copies are provided for Jeff Randorf, CSSD-SA-SS. One copy is submitted for CSSD-IM-PA. One copy is submitted for Dynamics Research Corporation. Two copies are submitted for Defense Technical Information Center.

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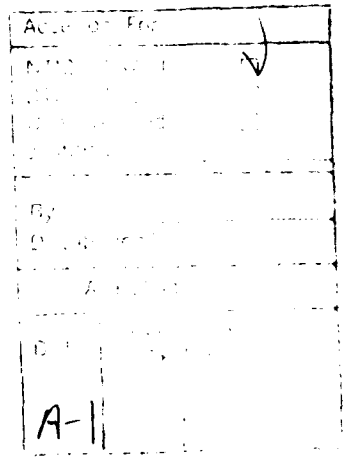

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

## REPORT DOCUMENTATION PAGE

*Form Approved OMB No. 0704-0188*

| | |
|---|---|
| 1a. REPORT SECURITY CLASSIFICATION<br>Unclassified | 1b. RESTRICTIVE MARKINGS<br>Not Applicable |
| 2a. SECURITY CLASSIFICATION<br>Unclassified | 3. DISTRIBUTION/AVAILABILITY OF REPORT<br>Unlimited Distribution |
| 2b. DECLASSIFICATION/DOWNGRADING SCHEDULE<br>Not Applicable | |
| 4. PERFORMING ORIGINATING REP NUMBER(S) | 5. MONITORING ORGANIZATION REPORT NUMBERS |
| 6a. NAME OF PERFORMING ORGANIZATION<br>TRW Inc.<br>System Development Division<br>6b. OFFICE SYMBOL *(If applicable)* | 7a. NAME OF MONITORING ORGANIZATION<br>U.S. Army Space & Strategic Defense Command |
| 6c. ADDRESS *(City, State, and ZIP Code)*<br>213 Wynn Drive<br>Huntsville, AL 35805 | 7b. ADDRESS *(City, State, and ZIP Code)*<br>P.O. Box 1500<br>Huntsville, AL 35807-3801 |
| 8a. NAME OF FUNDING/SPONSORING ORGANIZATION<br>6b. OFFICE SYMBOL *(If applicable)* | 9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER<br>DASG60-90-C-0092 |
| 8c. ADDRESS *(City, State, and ZIP code)* | 10. SOURCE OF FUNDING NUMBERS<br>PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO. |
| 11. TITLE *(Include Security Classification)*<br>Scientific and Technical Reports Summary--Annual and Final Report | |
| 12. PERSONAL AUTHOR(S)<br>Jan M. Smedley | |
| 13a. TYPE OF REPORT<br>Final | 13b. TIME COVERED<br>FROM 6/1/90 to 9/30/93 |
| 14. DATE OF REPORT *(Year, Month, Day)*<br>1993 September 30 | 15. PAGE COUNT<br>7 |
| 16. SUPPLEMENTARY NOTATION<br>Prepared as CDRL A005 under DCDS Support Contract | |

| 17. COSATIC CODES | | |
|---|---|---|
| FIELD | GROUP | SUB-GROUP |
| | | |

18. SUBJECT TERMS *(Continue on reverse if necessary and identify by block number)*

| | |
|---|---|
| DCDS | Distributed Computing Design System |
| CAIS-A | Common APSE Interface Set-Application |
| APSE | Ada Programming Support Environment |
| OSF | Open Software Foundation |
| CASE | Computer Aided Software Engineering Environment |

19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*

This report summarizes the activities under the Distributed Computing Design System program. The DCDS program was responsible for the support of the DCDS environment, developed under contract to USASDC. The DCDS environment is an integrated set of tools, languages, and methodologies designed to support the entire life-cycle of system/software development. This LOE contract provided technical assistance, training, distribution, configuration management, sustainment, and enhancement of DCDS.

| | |
|---|---|
| 20. DISTRIBUTION/AVAILABILITY OF ABSTRACT<br>[X] UNCLASSIFIED [ ] SAME AS RPT. [ ] DTIC USERS | 21. ABSTRACT SECURITY CLASSIFICATION<br>Unclassified |
| 22a. NAME OF RESPONSIBLE INDIVIDUAL<br>Jeff Randorf | 22b. TELEPHONE *(Include Area Code)*<br>(205) 955-5576<br>22C. OFFICE SYMBOL<br>CSSD-SA-SS |

**DD FORM 1473, JUN 86**

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SECURITY CLASSIFICATION OF THIS PAGE

56561-G470-176

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Reviewed By:

Jan M. Smedley
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# DCDS Scientific and Technical Reports Summary

## 1.0 Objectives

The overall objective of the Distributed Computing Design System (DCDS) program was to ensure that the DCDS environment was usable by Government programs and contractors developing large, real-time systems. The DCDS environment consists of an integrated set of tools, methodology, and languages designed to support the entire life-cycle of system/software development. DCDS was originally developed by TRW as a proof of concept tool to determine the effectiveness of building software to assist in analyzing requirements. Through of the continued support of USASSDC, formerly USASDC and BMD, TRW has been evolved the technology into a CASE tool comparable to commercial products used throughout the defense industry. Because it was developed with real-time, distributed systems in mind, DCDS is more complex and powerful than other CASE tools available on the commercial market. Support of DCDS required expertise not only in sustainment and enhancement of DCDS toolset, but also in the development of SDIO systems. Through the DCDS contract TRW provided sustainment and enhancement of the environment, active technical customer support, and specialized training support. This contract was originally established for a 24 month period. Due to funding limitations and the continued demand for DCDS, the contract was extended an additional 12 months.

## 2.0 Technical Problems

The DCDS project was initially focused on providing user support, training, and minimum sustainment to the environment. At that point in time it was believed that DCDS would be replaced by events and a subsequent contract. From June of 1990 through June of 1991, the DCDS TRW support team consisted approximately four people. As time progressed, the demand for DCDS increased and the customer community realized that replacing DCDS would not be an easy task. DCDS' flexible Element-Relationship-Attribute model, extendible by the user, provided a unique foundation for adapting the environment to meet specific project needs. Many of the "buzz word" capabilities of today could already be provided by DCDS. DCDS *elements* were really *entities* and could be converted into *objects*. DCDS was built with flexibility and extendibility in mind. DCDS provided an extensive query capability. Using DCDS, the user can customize his

own methodology with consistency analysis support without software modifications. The DCDS methodology and underlying software could evolve easily with technology. However one major problem existed, DCDS platform base was limited to VAX/VMS and Sun 3 system platforms. Support of SunView/SunCore, the user interface software used in the Sun 3 development, was dropped by Sun. The VAX/VMS interface dated back of 1985. The DCDS User Interface had to be brought up to standards for the continued success of DCDS.

## 3.0 General Methodology

The general process methodology behind the DCDS development was to use DCDS as a CASE tool to manage the project, develop and enhance the software, and assist in test and verification. By applying DCDS in the development of DCDS, TRW became users as well as developers. Through the application of DCDS, project milestones and schedules could be traced and maintained in accordance with Government directives. During the first two years of the contract focus was on technical assistance, followed by training. During the past year focus was shifted from technical support to tool enhancement with emphasis on the user interface design.

## 4.0 *Technical Results*

The accomplishments of this contract can measured by the ever-increasing acceptance and use of DCDS within USASSDC and other Government agencies.

### 4.1 Technology Transfer

#### 4.1.1 User Support

DCDS has been installed in over 160 sites. During the past year alone, over thirty-four copies of DCDS have been distributed. In conjunction the DCDS support team has provided consultation to the individual sites, handling several hundreds of user telephone calls.

#### 4.1.2 Training

Since the training program was initiated in June of 1989, TRW has trained over 300 people, representing USASSDC, Army, Navy, Air Force, Department of Energy, National Security Agency, and NASA. The demand for additional training has increased. Three formal training classes, Introduction to DCDS, DCDS for Managers, and DCDS

Software Engineering Methodology Training, were developed under this contract. During the past year more specialized training classes (i.e., classes developed using attendees requirements) have been developed and conducted. Using customer requirements provides a common foundation for the training and assists the customer in understanding the usefulness of the environment. These types of classes enforce the need for a tool such as DCDS for requirement analysis. Customer response to the tailored classes was extremely positive with comments such as "I knew that our requirements were in bad shape--but I didn't realize how bad! This class was a real eye-opener."

#### 4.1.3 Cooperative Research and Development Agreements

In June of 1992 TRW was directed by USASSDC to distribute copies of the DCDS Sun and VAX source code and associated document to CONVEX in support of a Cooperative Research and Development Agreement (CRDA) with USASSDC. Under the CDRA TRW supported CONVEX in rehosting DCDS to a CONVEX platform. This CRDA was a remarkable success. The CONVEX team did an exceptional job. CONVEX complemented TRW on how well the DCDS source code was written and organized with less than 40 lines of the Ada software requiring modification prior to initial compilation.

### 4.2 Enhancement Activities

Under this contract TRW made significant progress in productizing the DCDS environment. Using customer input. TRW worked with USASSDC to prioritize requests and focus attention on the most important areas. Some of the most significant enhancements are highlighted in the following sections.

#### 4.2.1 Unified Database

TRW enhanced traceability within DCDS by combining the system and software requirements and test support methodologies into a single database. Previous DCDS versions provided separate databases for each life cycle phase. While this approach separated areas of concern and prevented individual conflict, some manual effort was required to ensure traceability

from phase to phase. By combing the databases, traceability information is immediately visible and no information can be accidentally lost.

#### 4.2.2 Enhanced Database Management Support

To assist in assessing information in the unified database, TRW enhanced the underlying database management system (DBMS). TRW redesigned the DBMS to allow users to establish baseline databases from which subordinate databases could be created. The baseline databases were "write locked" to maintain integrity, but visible to lower levels. The information at the subordinate databases could later be exported and merged into the baseline database using standard features of DCDS.

#### 4.2.3 Enhanced Configuration Management

To assist in ensuring database integrity, TRW enhanced the DBMS to include a session audit capability. If enabled, the date, time, change, and user identification associated with each change is logged into an encrypted log file. The log file can be archived or printed. The archive file provides a CM trace of all actions performed on the database. The print capability displays to the screen or prints to a designated file a log of all transactions.

#### 4.2.4 Enhanced Security Features

TRW also designed security features to prevent unauthorized access to DCDS as well as an individual DCDS database. The DCDS software checks to determine if a user is authorized to use DCDS prior to execution. In addition the user can establish permission levels within the database to allow others to read and/or update the database.

#### 4.2.5 Common APSE Interface Set-Application (CAIS-A) Prototypes

TRW built two prototypes to access the feasibility and effectiveness of integrating DCDS with frameworks using SofTech's CAIS-A implementation. In the initial prototype the DCDS database was stored as file nodes within the CAIS-A entity-relationship-attribute model. In the second prototype a subset DCDS element-relationship-attribute (ERA) database

package was rewritten to access the CAIS-A database. Both tasks were accomplished in less than 3 man-months. At t completion of task, recommendations and lessons learned as well as a demonstration was provided to representatives from the Ada Joint Program Offi.e, USASSDC, Naval Oceans System Center (NOSC), and SofTech.

### 4.2.6 DCDS Restructure

During the past year TRW restructured and redesigned the internal DCDS software. The foundation for the redesign, as documented in the CAIS-A Task Report, was to provide a more portable environment and to streamline incorporation of enhancements. In the past DCDS upgrades have been hampered by system dependencies. Under this restructure a clear separation of DCDS toolset core (i.e., the Database Management System, Translators, Query capabilities, etc.) and user interface software was performed. The core system dependencies were isolated into a single package. The core software was initially developed on the VAX under VMS due to lack of available hardware. This software was later ported to the Sun SPARCstation using SunOS. As the development progressed, both systems were maintained to ensure portability between the two environments with vastly different hardware and operating system configurations. The goal was to reduce potential impacts of migrating to other platforms as well as eliminate problems when operating systems and associated software are upgraded.

In the core redesign, the separate tool approach (i.e., Entry, Extend, Query) used in previous implementations was replaced with a single Command Executive. The Command Executive software provides connectivity to other DCDS packages and verifies the completeness and accuracy of each command prior to processing. It can be accessed through a single call from the User Interface service. It may also be accessed without the user interface by means of an input file. This provides a method of using DCDS in a batch environment. Labor intensive tasks, such as producing a report, running consistency analysis checks, or exporting the database for

backup, may be executed without having to monitor the terminal.

The new Command Executive also provides a method of interfacing DCDS with other COTS. Since one central command executive exists for all DCDS activities, interfacing with other tools is simplified. Each DCDS command is clearly identified in a formal BNF format. Interaction between DCDS and COTS could take place via a file of DCDS commands.

### 4.2.7 User Interface Redesign

In conjunction with the restructuring activities, TRW redesigned a new user interface using OSF/Motif. The goals of the redesign were to provide a more portable interface, to improve user interaction, to focus attention on life-cycle development, and to support follow efforts. By designing the User Interface using Motif, the man-effort to port to other platforms is greatly reduced. The User Interface from the user perspective is drastically different from the previous interfaces. To improve user interaction, the need to move from tool to tool for inputting and retrieving information was eliminated. The interface is more compact and requires less traversing of menus. The need to learn the DCDS syntax was eliminated. The interface guides the user through the session and assists in using and understanding the methodologies. This approach reduces the amount of user errors. The interface provides easier access to system engineering information. By utilizing the basic query capability, menu selections have been added to allow the user to review basic system information with a click of a button. Again, the emphasis was to hide the syntax from the user in order to focus attention on developing the system, not learning DCDS syntax.

When DCDS is initially executed, a main menu or control panel is displayed. This control panel will remain displayed unless explicitly closed by the user. The control panel provides display status information concerning the current session. The control panel contains a command line. Any DCDS command can be entered from the command line. The

command line was provided for experienced DCDS users. This command line is the only command line which appears in the interface. The control panel also contains menu selections including--

- Database: To create a new database, load an existing database, archive a database, or restore a database
- Schema: To add, modify, or delete any part of standard or customized schema
- Instances: To add, modify, or view any database instance
- Query: To retract and analyze database contents
- View: To view a particular set of information, such as traceability of requirements, physical component architecture, subsystem to subsystem interfaces, functional decomposition
- Check: To check the consistency of the database, including requirements that have not been traced, subsystems that are not interfaced, items that have no source or sink.

## 5.0 Important findings and conclusions

This contact marks the end of an era for TRW and DCDS. At its conclusion significant strides were made to improve the environment into a commercial product. The beta release of DCDS has been distributed to a limited set of customers. Initial response from the DCDS customer community was extremely positive. User influence on the design and task prioritization is a must for DCDS.